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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Automobile Engineering

Semester End Examination; Dec. - 2015

Material Science and Metallurgy

Time: 3 hrs *Max. Marks: 100*

Note: *i) Answer **FIVE** full questions selecting **ONE** full question from each **unit**.*
ii) Assume suitably missing data if any.

UNIT - I

1 a. Sketch the unit cell of BCC and FCC and find out the number of atoms per unit cell and packing factor of both BCC and FCC. 9

b. Nickel has FCC crystal structure with a lattice parameter of 0.352 nm. What is the value of atomic radius in nanometer? 4

c. Classify crystal imperfections. Explain the point imperfections in brief. 7

2 a. State and explain the Fick's law of Diffusion. 6

b. Explain the mechanisms of diffusion in solids. 6

c. An Industrial component made of high carbon steel (0.8% c) is exposed to an oxidaising environment at 1000ºC for a period of 1 hour. Determine the depth at which the carbon content will be reduced to 0.4%. Given D, the diffusion coefficient for C in iron is 3.11×10^{-11} m^2/s at 1000ºC. Assume that the concentration of the carbon in the environment is zero throughout the exposure period. Take; erf (0.5) = 0.5. 8

UNIT - II

3 a. Define Engineering stress and strain, true stress and true strain. Establish the relation between true stress and engineering stress. 8

b. A low carbon steel rod is subjected to tensile load of 7000 kg. Assuming no volume change during extension, determine engineering stress and strain, true stress and true strain. The initial diameter of rod is 13 mm and the specimen under the load is 12 mm. 8

c. Define the following: i) Stiffness ii) Resilience 4

4 a. Define creep with typical creep curve. Explain different stages of creep. 8

b. What do you understand by fatigue of materials? How does a metal or alloy fail by fatigue? 6

c. Explain the stages in cup and cone ductile fracture with neat sketches. 6

UNIT - III

5 a. What is solid solution? With suitable example explain the different types of solid solutions. 8

b. A binary alloy of M and N contains 56% phase and 44% of liquid phase. The composition of solid and liquid phases is 28% N and 72% N respectively. What is the overall composition of the alloys? 7

Contd….2

c. State the Gibb's phase rule and explain the various terms. 5

6. a. Draw the iron-carbon equilibrium diagram and label all phase fields. Write the invariant reactions. 10

b. What is TTT diagram? Draw a TTT diagram of an eutectoid steel and explain the transformation the Austenite. 10

UNIT - IV

7 a. What is heat treatment? Classify the various heat treatment processes. Give the purposes of heat treatment. 7

b. What is surface hardening? Name various surface hardening processes for steels. 5

c. Define hardenability. Explain with neat sketches the joining-end quench test. 8

8 a. Explain Austempering and Martempering with sketches. 8

b. Explain the following : 8

i) Annealing ii) Normalising

c. Distinguish between Hardness and Hardenability of a steel. 4

UNIT - V

9 a. State and properties and uses of gray cast iron, malleable cast iron and nodular iron. 10

b. Give the typical composition, properties and uses of the following alloys: 10

(i) Bronze ii) Aluminium copper alloys.

10 a. What are the composite? Classify composite materials, why and how are composites superior to conventional materials? 10

b. Explain the fundamentals of production of MMC's. 10

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